CHAPTER 2.0

Cell Structure and Functions

2.1
Prokaryotic and Eukaryotic cell
Cell as a unit of life

- Prokaryotic and eukaryotic cells
- Microscopic structures of plant and animal cell
- Structure and functions: cell membrane and organelles
- Plant cell
  - Nucleus
  - Mitochondria
  - Rough and smooth endoplasmic reticulum
  - Golgi body
  -- Ribosome
  -- Lysosome
  -- Chloroplast
  -- Centriole
- Animal cell
- Compare
- Cell transport
  - Passive transport
  - Active transport
- Cell are grouped into tissue

Plant
- Animal

Cell theory

Figure 1.2
2.1 PROKARYOTIC AND EUKARYOTIC CELLS

Cell Theory

Robert Hooke

CELL
The Cell Theory

1. All living things are composed of cells.
2. Cells are the basic units of structure and function in living things.
3. New cells are derived from existing cells by cell division.
4. Cells contain the hereditary material of an organism which is passed from parent cell to daughter cell.
• **Nucleus** – large membrane-enclosed structure that contains the cell’s genetic information.

• **Prokaryotes** – cells that do not contain nuclei. (Bacteria)

• **Eukaryotes** – cells that contain nuclei. (All other organisms)
2.1 Prokaryotic & Eukaryotic Cells...

Types of cells

“before the nucleus.”

i. Prokaryotic cell

“True nucleus”

ii. Eukaryotic cell

a. Plant cell

b. Animal cell

Comparison
Prokaryotic cell

- **No** nucleus
- A prokaryote is a **single-celled** organism
- Very **small**: 0.5 - 10 μm (micrometers)
- **No** membrane-bound organelles and
- has a **single circular chromosome**.
The Prokaryotic cell - Bacteria

**Structure & Function**

![Prokaryotic Cell Structure](image)

- Cytoplasm
- Nucleoid
- Capsule
- Cell Wall
- Cytoplasmic Membrane
- Ribosomes
- Pili
- Flagella

**Figure 1**
**STRUCTURE OF PROKARYOTIC CELL**

- Pili
- Single, circular DNA
- Ribosome
- Flagellum
- Capsule
- Cell Wall
- Nucleoid
- Plasma membrane
STRUCTURE OF PROKARYOTIC CELL

- Pili
- Single, circular DNA
- Ribosome
- Flagellum
- Capsule
- Cell Wall
- Plasma membrane
- Nucleoid
- Dense region of DNA in prokaryotic cell

No nuclear membrane
made up of phospholipids for exchange of waste product and nutrients.
**Structure of Prokaryotic Cell**

- **Pili**
- **Single, circular DNA**
- **Plasma membrane**
- **Ribosome**
- **Flagellum**
- **Capsule**
- **Cell Wall**
- **Nucleoid**
- **Plasma membrane**

- Surround the plasma membrane
- Made of peptidoglycan
- Maintain the shape and protect the cell.
Structure of prokaryotic cell:

- Single, circular DNA
- Plasma membrane
- Pili
- Ribosome
- Flagellum
- Cell Wall
- Nucleoid
- Capsule: polysaccharide or protein coating secreted outside the cell wall
Structure of prokaryotic cell

- Pili: used for movement, may or may not be present.
- Single, circular DNA
- Plasma membrane
- Ribosome
- Flagellum
- Capsule
- Cell Wall
- Nucleoid
- Plasma membrane
- Ribosome
- Pili

- attach to the surface
- for exchange of genetic material (conjugation).
tiny organelles found in large numbers in the cytoplasm
Eukaryotic cell

- Linear strands of DNA contained in nucleus
- Contain many organelles, have membrane bounded organelles
Eukaryotic cell

- Flagella and cilia, if present
  – constructed from a system of $9 + 2$ microtubules

- Eukaryote - Unicellular, filamentous, multicellular organism with larger cell size compared to prokaryote
  - e.g.: Protists, fungi, plant, animal
9 + 2 microtubules
The Eukaryotic cell

Plant cell

Animal cell
Comparison between prokaryotic and eukaryotic cells
### Differences

<table>
<thead>
<tr>
<th>Prokaryote</th>
<th>Eukaryote</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cell size:</strong> 0.5-10 μm</td>
<td><strong>Cell size:</strong> 10-100 μm</td>
</tr>
<tr>
<td>The size is smaller than eukaryotic cell.</td>
<td>The size is larger than prokaryotic cell.</td>
</tr>
<tr>
<td><strong>Cell division:</strong> Mostly binary fission</td>
<td>Mitosis, meiosis @ both</td>
</tr>
<tr>
<td><strong>DNA lies free in cytoplasm</strong></td>
<td><strong>DNA contain in nucleus</strong></td>
</tr>
<tr>
<td><strong>DNA is circular &amp; not associated with histone protein</strong></td>
<td><strong>DNA is linear &amp; associated with histone protein</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Prokaryote</strong></td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td>Few organelles,</td>
<td>Membrane bound organelles are <strong>absent</strong></td>
</tr>
<tr>
<td>Cell wall</td>
<td>Cell wall consists of <strong>peptidoglycan</strong></td>
</tr>
<tr>
<td>Flagella:</td>
<td>Simple, lacking <strong>microtubules arrangement</strong></td>
</tr>
<tr>
<td>Ribosomes</td>
<td><strong>smaller</strong> (<strong>70S</strong>)</td>
</tr>
<tr>
<td><strong>Prokaryote</strong></td>
<td><strong>Eukaryote</strong></td>
</tr>
<tr>
<td>----------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Respiration occurs at <strong>mesosomes</strong> in bacteria, except cytoplasmic membranes in blue green bacteria</td>
<td>Respiration occurs at <strong>mitochondria</strong> in aerobic respiration</td>
</tr>
<tr>
<td><strong>No chloroplasts</strong>, but have photosynthetic pigment for photosynthesis to occur</td>
<td>Photosynthesis occur in <strong>chloroplast</strong></td>
</tr>
<tr>
<td>Some have the <strong>ability to fix nitrogen</strong></td>
<td><strong>None</strong> have the ability to fix nitrogen</td>
</tr>
</tbody>
</table>
SIMILARITIES

• Both are surrounded by a plasma membrane
• Both contain chromosomes / DNA
• Both also have ribosomes
**TABLE 4.2 Principal Differences Between Prokaryotic and Eukaryotic Cells**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Prokaryotic</th>
<th>Eukaryotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of cell</td>
<td>Typically 0.2–2.0 μm in diameter</td>
<td>Typically 10–100 μm in diameter</td>
</tr>
<tr>
<td>Nucleus</td>
<td>No nuclear membrane or nucleoli</td>
<td>True nucleus, consisting of nuclear membrane and nucleoli</td>
</tr>
<tr>
<td>Membrane-enclosed organelles</td>
<td>Absent</td>
<td>Present; examples include lysosomes, Golgi complex, endoplasmic reticulum, mitochondria, and chloroplasts</td>
</tr>
<tr>
<td>Flagella</td>
<td>Consist of two protein building blocks</td>
<td>Complex; consist of multiple microtubules</td>
</tr>
<tr>
<td>Glycocalyx</td>
<td>Present as a capsule or slime layer</td>
<td>Present in some cells that lack a cell wall</td>
</tr>
<tr>
<td>Cell wall</td>
<td>Usually present; chemically complex (typical bacterial cell wall includes peptidoglycan)</td>
<td>When present, chemically simple</td>
</tr>
<tr>
<td>Plasma membrane</td>
<td>No carbohydrates and generally lacks sterols</td>
<td>Sterols and carbohydrates that serve as receptors present</td>
</tr>
<tr>
<td>Cytoplasm</td>
<td>No cytoskeleton or cytoplasmic streaming</td>
<td>Cytoskeleton; cytoplasmic streaming</td>
</tr>
<tr>
<td>Ribosomes</td>
<td>Smaller size (70S)</td>
<td>Larger size (80S); smaller size (70S) in organelles</td>
</tr>
<tr>
<td>Chromosome (DNA)</td>
<td>Single circular chromosome; lacks histones</td>
<td>Multiple linear chromosomes with histones arrangement</td>
</tr>
<tr>
<td>Cell division</td>
<td>Binary fission</td>
<td>Mitosis</td>
</tr>
<tr>
<td>Sexual reproduction</td>
<td>No meiosis; transfer of DNA fragments only</td>
<td>Involves meiosis</td>
</tr>
</tbody>
</table>
(a) Highly schematic diagram of a composite eukaryotic cell, half plant and half animal
End of session

Thank you for your attention